

# CAMBRIAN ORIGINS OF THE ODONTOPLEURID TRILOBITES

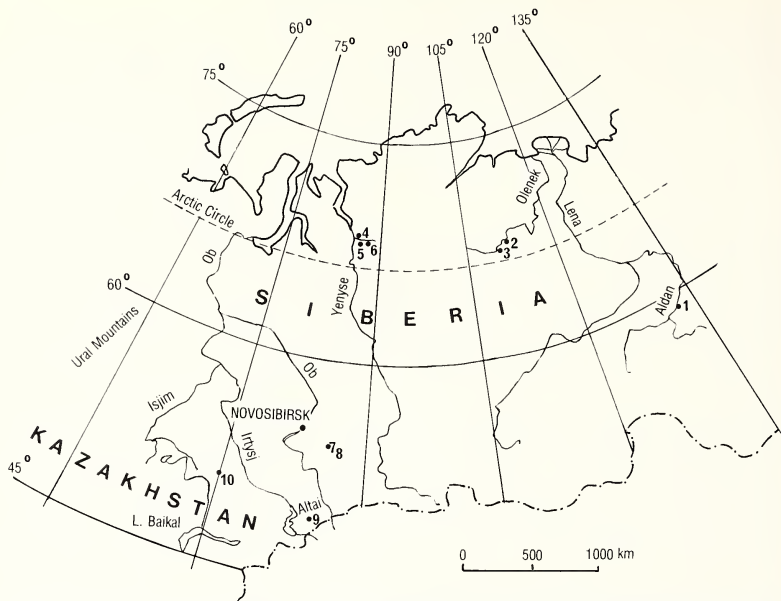
by DAVID L. BRUTON

**ABSTRACT.** Type and topotype material of middle and upper Cambrian odontopleuracean trilobites is described from the Soviet Union and new family and generic diagnoses are given. *Belovia*, *Acidaspidina*, and *Eoacidaspis* are assigned to the Family Eoacidaspididae, *Acidaspides* and *Acidaspidella* to the Odontopleuridae. Holaspid cranidia of *Acidaspides* resemble those of early Ordovician *Primaspis* (Odontopleurinae), pre-holaspid growth stages resemble certain Miraspidinae, and *Acidaspidella* resembles *Leonaspis*. This confirms the view of Whittington that *Primaspis* and *Leonaspis* are among the root-stocks of the Odontopleurinae. The range of the Odontopleuridae is middle Cambrian to upper Devonian making this one of the longest living trilobite families.

AMONGST the rich diversity of trilobites inhabiting marine environments in the Ordovician, Silurian, and Devonian are those which form a small family group, the Odontopleuridae. Their characteristic pustulose or thorn-like surface sculpture, lobate glabella, and spinose margins are features that allow even fragmentary material to be readily identified. The post-Cambrian life-span of the family is approximately 160 million years covering the period from the lower Ordovician (Arenig) to the upper Devonian. The origin of most Ordovician and later trilobite groups is cryptogenetic (Stubblefield 1960), but odontopleuracean ancestors are to be found among middle and upper Cambrian trilobites recorded in the last thirty years or so from Siberia, Kazakhstan, and China. Original type material is not well preserved, but in April and May 1965 I was able to examine this and additional material preserved at the Geological Institute, Moscow, and the Central Geological Museum (VSEGEI), Leningrad. Material from the Siberian Geological Institute (SNIIGGIMS), Novosibirsk, was obtained on loan and examined in Moscow. Latex moulds were taken of all specimens and a set of plaster casts made to illustrate this present work. These casts, together with actual specimens kindly presented to me by Drs. Pokrovskaya, Tchernysheva, and Lazarenko, are now housed in the Paleontologisk Museum, Oslo (hereafter abbreviated PMO).

Three publications by Professor H. B. Whittington, F.R.S. (Whittington 1956*a*, *b*; Whittington and Bohlin 1958), first drew my attention to the Odontopleuridae, and he has been a constant source of inspiration to me in my own interest in this group (Bruton 1968 and references). Whittington frequently commented on the long time range of certain genera. *Miraspis*, a genus widespread in Europe and North America, ranges from the Arenig (Whittington and Bohlin 1958) to the lower Devonian (Whittington 1956*a*) and its species exhibit so little variation that it is difficult to separate them. Evidence suggests that an animal well adapted to a particular environment may last for long periods without undergoing significant morphological change (Whittington 1962, p. 415). The nature of the environment in which odontopleurids lived is not known and while their thoracic and pygidial spines have suggested a floating or drifting habit, other spines, such as those along the antero-lateral cephalic margin, aided resting on the sea floor and thus a benthonic habit (Whittington 1956*b*; Clarkson 1969). In the following discussion it is shown that described middle and upper Cambrian trilobite faunas contain forerunners of the Odontopleuridae demonstrating that the family has one of the longest evolutionary histories among the Trilobita.

Text-fig. 1 shows the geographical distribution of odontopleuraceans described from the upper Cambrian of Kazakhstan (Lermontova 1951; Chugaeva and Apollonov 1982) and the middle and upper Cambrian of Siberia (Tchernysheva 1953, 1960*b*; Poletaeva 1956, 1960*a*, 1960*b*, 1969, 1977; Lazarenko 1960, 1968; Rozova 1963, 1964, 1968; Lazarenko and Datsenko 1967; Lazarenko and



TEXT-FIG. 1. Map of Siberia and part of Kazakhstan with type localities for: (1) *Acidaspides lemontovae*; (2) *Belovia calva*; (3) *Acidaspides borealis*; (4) *Acidaspidina plana*; (5) *Acidaspidella limita*; (6) *Eoacidaspis amplicauda*, *Belovia aliquidantula*, *B. laeta*, *B. cyclica*; (7) *Eoacidaspis salairica*; (8) *Belovia salairica*, *B. radugini*; (9) *B. media*; (10) *Acidaspides precurrens*.

Nikiforov 1968; Zuravleva and Rozova 1977). Material has also been recorded from the upper Cambrian of South China (Poletaeva 1960a), although it is not well known. The first taxon to be described from the Soviet Union was the upper Cambrian *Acidaspides precurrens* Lermontova, 1951 (pp. 27-29, pl. 6, figs. 4-9; herein Pl. 88, figs. 12, 15). Later Tchernysheva (1953, pp. 81-82, pl. 6, figs. 16-17) described *A. lemontovae* (Pl. 88, fig. 7) from the late middle Cambrian. Poletaeva (1956) established two monotypic genera, *Belovia* (middle-upper Cambrian) and *Eoacidaspis* (upper Cambrian), and later (Poletaeva 1957, pp. 162-164) the new family Eoacidaspidae (Eoacidaspidae *nom. correct.* Jaanusson in Moore 1959, p. O509) was erected to embrace these genera and *Paraacidaspis* Poletaeva, 1957 *nom. nud.* (non 1960 *nom. nud.*). The Eoacidaspidae were regarded as a primitive branch of odontopleuraceans which became extinct in the upper Cambrian. *Acidaspides* was considered to be a direct ancestor of the post-Cambrian odontopleurids and was thus included in the Odontopleuridae. More recently *Acidaspidina* Lazarenko, 1960 and *Acidaspidella* Rozova, 1963 non Pokrovskaya, 1961, have been described from the upper Cambrian of Siberia.

All known material is of cranidia, associated pygidia being only doubtfully assignable to this group.

In the following account, evidence is produced to show that *Acidaspidina* (early upper Cambrian) was derived from the same root-stock that gave rise to *Eoacidaspis* (late upper Cambrian) and that these and *Belovia* (middle-early upper Cambrian) together form the Eoacidaspidae. *Acidaspidella* (upper Cambrian) and *Acidaspides* (middle Cambrian-?Tremadoc) were derived from a *Belovia*-like root-stock and gave rise to the post-Cambrian Odontopleuridae to which family they are assigned.

## SYSTEMATIC PALAEOLOGY

### Family EOACIDASPIDIDAE Poletaeva, 1957

*Diagnosis.* Anterior facial sutures strongly divergent in front of eyes. Latter placed far back, eye ridges prominent. Cranium with prominent anterior border, separated from glabella by distinct furrow. Glabella long (sag.), trapezoidal, occipital ring narrow, occipital furrow deep, curved forward medially. Dorsal furrows well-defined posteriorly, deflected around L2. Latter oval, S1 deepened at inner end, S2 and S3 weak to obsolete. Surface smooth to weakly granulose.

*Stratigraphical range.* Late middle Cambrian to Tremadoc.

*Genera.* *Eoacidaspis* Poletaeva, 1956; *Belovia* Poletaeva, 1956; *Acidaspidina* Lazarenko, 1960.

*Discussion.* Poletaeva (1957) recognized two distinct root-stocks in the late middle Cambrian and established the family Eoacidaspidae (*nom. correct.*) for *Eoacidaspis* and *Belovia*. While leaving *Acidaspides* unassigned, she recognized that this genus should be regarded as a possible ancestor of the post-Cambrian odontopleurids. In 1960 she repeated this idea (Poletaeva 1960a), and emended the family diagnosis to accommodate a third genus, *Paraacidaspis nom. nud.* This seems to have been overlooked by subsequent revisers (Jaanusson *in* Moore 1959; Kobayashi and Hamada 1977) including most Soviet palaeontologists who assign all Cambrian odontopleuraceans to the Eoacidaspidae. However, Maximova *in* Tchernysheva (1960a) followed Poletaeva's original suggestion regarding the Eoacidaspidae, but assigned *Acidaspides* to the Odontopleurinae (= Odontopleuridae). Study of all the material in question has led me to similar conclusions, summarized in text-fig. 2. I thus believe that *Acidaspidina* was derived from the same root-stock that gave rise to *Eoacidaspis* and that these and *Belovia* together form the Eoacidaspidae. *Acidaspidella* Rozova, 1963 and *Acidaspides* Lermontova, 1951 are assigned to the Odontopleuridae Burmeister, 1843 (see Whittington *in* Moore 1959), *Acidaspides* being a direct ancestor of the post-Cambrian Odontopleurinae. Features shared between *Acidaspidella* and *Acidaspides* include the narrow upturned anterior border, straight anterior facial suture, well-defined dorsal furrows, and long (sag.) occipital ring with median tubercle. The sinuous dorsal furrow and the prominent L2 lobe in *Acidaspidella* is a feature shown in *Acidaspidina*, suggesting that the odontopleurid line was derived from the same root-stock which gave rise to *Acidaspidina* and *Eoacidaspis* sometime in the late middle Cambrian.

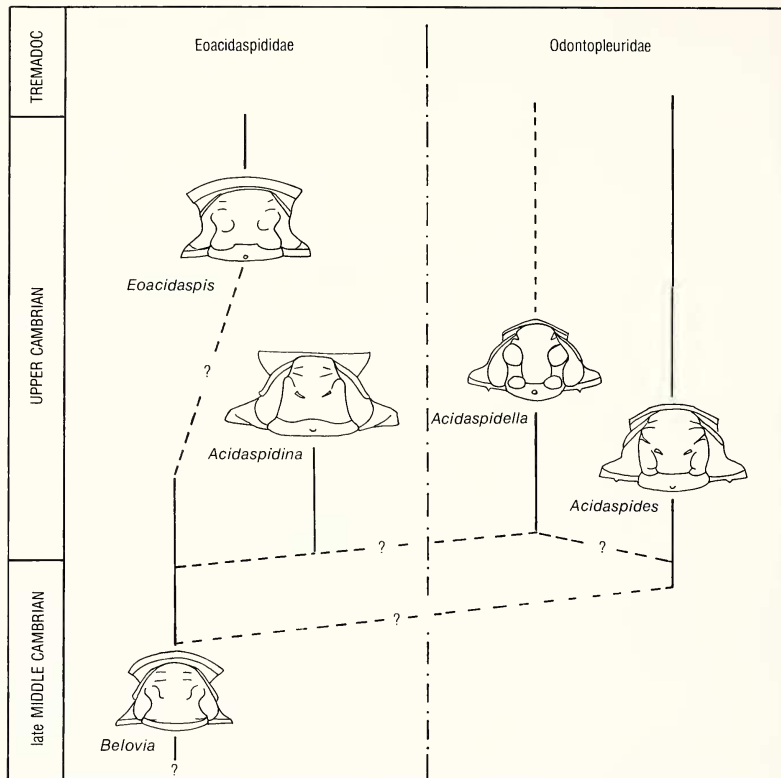
The origin of the Eoacidaspidae is unknown and more skeletal parts (pygidia, free cheeks, details of ventral sutures, etc.) are needed before comparison with earlier stocks is possible. Kobayashi (1962) and Kobayashi and Hamada (1977) have suggested a relationship with the Corynexochida, but studies on the ontogeny of a representative of this group (Robison 1967) show no resemblance to early growth stages among the Eoacidaspidae. Likewise, the relationship between the Eoacidaspidae, the Amgaspidae Tchernysheva, 1960, and Bestjubbellidae Ivshin, 1962, is particularly obscure and type material needs to be examined before further remarks can be made.

### Genus EOACIDASPIS Poletaeva, 1956

Plate 88, figs. 3, 4, 8, 9

*Type species.* *Eoacidaspis salairica* Poletaeva, 1956, p. 175, pl. 32, figs. 5, 6, upper Cambrian, Salair Ridge, western Siberia.

*Other species.* *E. amplicauda* Lazarenko, 1968, p. 196, pl. 18, figs. 10-16.



TEXT-FIG. 2. Morphological grouping of the Cambrian Eoacidaspidae and Odontopleuridae.

*Diagnosis.* Glabella waisted at approximately half sagittal length, dorsal furrows sinuous and deep especially posteriorly. L2 with independent convexity, longest axis oblique at  $45^\circ$  to sagittal line; S1 deepest around base of lobe, very deep on internal mould. L1 flat, weakly developed except posteriorly at lateral deepening of occipital furrow. S2 and S3 short, transverse furrows. Sutures strongly divergent. Surface with granules forming raised pattern.

*Discussion.* The cranidium (Pl. 88, figs. 8, 9), which is an internal mould, is one of several original paratypes of *E. salairica*, while the cranidium (Pl. 88, figs. 3, 4) is of topotype material of *E. amplicauda* Lazarenko, 1968. Both show the pronounced oval L2 lobe and the more quadrate L1 lobe, especially pronounced on the internal mould. All previously illustrated material, including that by Rozova (1968, pl. 9, fig. 19) is from the western part of Siberia where it occurs in the late upper Cambrian.

Chugaeva and Apollonov (1982, text-fig. 1) list an occurrence as '*Eoacidaspis*' near to the Cambrian-Ordovician boundary in Kazakhstan.

Poletaeva (1957, pp. 162-163) listed *Paraacidaspis nom. nud.* and later (1960a, p. 68, pl. 3, fig. 1) diagnosed the genus and figured the holotype of the type species, *P. hunanica* Jegorova in Poletaeva, 1960, *nom. nud.*, from the upper Cambrian Ch'an-shan Stage, Hunan Province, south China. Since the type species was not formally described, the genus *Paraacidaspis* is invalid. Study of the cranidium of *P. hunanica nom. nud.* and a second species, *P. sibirica* Poletaeva, 1960 (p. 70, pl. 3, fig. 2) from the upper Cambrian of western Siberia, leaves little doubt that *Paraacidaspis* is a subjective synonym of *Eoacidaspis*.

*Stratigraphical and geographical distribution.* Late upper Cambrian-basal Ordovician. Salair Ridge, western Siberia, Kazakhstan.

### Genus *Belovia* Poletaeva, 1956

Plate 88, figs. 1, 2

*Type species.* *Belovia calva* Tchernysheva in Poletaeva, 1956, p. 174, pl. 32, fig. 10, from late middle Cambrian, Olenek River, eastern Siberia.

*Other species.* *B. salairica* Poletaeva, 1960b, p. 241, pl. 27, fig. 17; *B. aliquantula* Rozova, 1964, p. 54, pl. 4, fig. 21; *B. laeta* Rozova, 1964, p. 55, pl. 14, figs. 8-9; *B. cyclica* Rozova, 1964, p. 56, pl. 17, figs. 14-16; *B. media* Poletaeva, 1977, p. 72, pl. 1, fig. 1; *B. radugini* Poletaeva, 1977, p. 70, pl. 1, fig. 2.

*Diagnosis.* Glabella waisted at approximately half sagittal length and level with S1 furrow. Latter transverse at inner end, moderately deep. L1 and L2 faintly defined. S2 and S3 faint. Anterior portion of glabella weakly defined, tapering forwards, rounded frontal lobe, posterior portion expanding backwards with well-defined dorsal furrows and occipital furrow. Occipital ring narrow and smooth. Fixed cheeks widest opposite S1, rapidly tapering forwards, here eye ridge and lateral parts of glabella in contact. Eyes level with S1. Sutures strongly divergent. Frontal glabellar lobe separated by deep furrow from flattened and raised anterior border. Latter curved. Surface smooth.

*Discussion.* The holotype by monotypy of the type species (Pl. 88, figs. 1, 2) was described by Tchernysheva (p. 174) in the same publication as that in which Poletaeva (1956, p. 173) established the genus. The type species is from the late middle Cambrian where it is common in beds belonging to the so-called Siligiz Horizon equivalent to the Swedish middle Cambrian Zone of *Lejopyge laevigata*. One species, *B. cyclica* Rozova, 1964 has been recorded from the upper Cambrian Zone of *Agnostus pisiformis*.

Originally *Belovia* was assigned by Poletaeva (1956) to the Odontopleuridae but later (Poletaeva 1957, 1960a) it was placed in the Eoacidaspidae together with the younger *Eoacidaspis* and *Paraacidaspis nom. nud.* *Belovia* and *Eoacidaspis* have in common the waisted glabella, sinuous dorsal furrows, the diverging anterior facial suture, and the prominent rim along the anterior border. *Eoacidaspis* has more prominent L1 and L2 lobes and a broader occipital ring.

Numerous described and undescribed species of *Belovia* show a whole plexus of evolving forms with transitional morphotypes from *Belovia* to *Eoacidaspis*.

*Stratigraphical and geographical distribution.* Late middle Cambrian to early upper Cambrian, northern and north-west Siberian Platform, eastern Siberia, Olenek River and western Siberia, Salair Ridge.

### Genus *Acidaspidina* Lazarenko, 1960

Plate 88, fig. 13

*Type species.* *Acidaspidina plana* Lazarenko, 1960, p. 39, pl. 4, figs. 9-12, from early upper Cambrian, Yenise River, north-west Siberian Platform.

*Diagnosis.* Glabella moderately convex, outlined along entire length by straight to gently sinuous dorsal furrows. L2 most prominent adjacent to dorsal furrow, base marked by short, deep slot of S1.

L1 weak. S2 short, backwardly directed, S3 transverse. Fixed cheeks widest posteriorly, tapering forwards, and dying out opposite outer end of S3. Occipital ring broad (sag.), furrow curved forwards. Small occipital tubercle near posterior margin. Anterior and posterior facial sutures strongly divergent. Surface finely granulated.

*Discussion.* The cranidium (Pl. 88, fig. 13) is that figured by Lazarenko 1960, pl. 4, figs. 9–10, from the early upper Cambrian Zone of *Glyptagnostus stolidus* on the north Siberian Platform. Here the genus occurs together with species of *Belovia* and *Acidaspidella* and is seemingly intermediate between the two in that the dorsal furrow is straighter than it is in *Belovia* and the glabellar furrows are more pronounced though not as much as in *Acidaspidella*. Lazarenko (1960, p. 40) believed *Acidaspidina* to be close to *Acidaspides* but the latter does not have the strongly divergent anterior facial suture and the glabellar lobes are more distinct. Features of the glabellar lobation and the anterior border are more clearly seen in specimens of *A. plana* described and figured by Rozova (1968, p. 88, pl. 3, figs. 16–18) and by Zuravleva and Rozova (1977, p. 68, pl. 3, figs. 7–10).

The type of pygidium associated with *Acidaspidina* by Lazarenko (1960, pl. 4, figs. 11–12) was thought by her to be similar to those assigned to the Anomocaridae. This is probably correct but the cranidium of *Acidaspidina* does not belong to that family.

*Stratigraphical and geographical distribution.* Early upper Cambrian (Chomurdakh Horizon), north Siberian Platform.

Family ODONTOLEURIDAE Burmeister, 1843 (emend. Whittington, 1956)

Genus *Acidaspides* Lermontova, 1951

Plate 88, figs. 7, 11, 12, 14–18

*Type species.* *Acidaspides precurrens* Lermontova, 1951, p. 27, pl. 6, figs. 4–9, from upper Cambrian, Kazakhstan.

*Other species.* *A. lermontovae* Tchernysheva, 1953, p. 81, pl. 6, figs. 16–17; *A. borealis* Tchernysheva, 1960b, p. 254, pl. 53, figs. 9–10.

EXPLANATION OF PLATE 88

All photographs are those of plaster casts except for figures 8, 9 which are of an actual specimen. CGML = Central Geological Museum, Leningrad; PMO = Paleontologisk Museum, Oslo.

Figs. 1, 2. *Belovia calva* Tchernysheva in Poletaeva, 1956. Holotype, CGML 20/8505, PMO 108.537, dorsal and oblique frontal view,  $\times 2$ . Original of Tchernysheva in Poletaeva 1956, pl. 32, fig. 10.

Figs. 3, 4. *Eoacidaspis amplicauda* Lazarenko, 1968. PMO 108.539, frontal and dorsal view,  $\times 2$ . Upper Cambrian, north-west Siberian Platform.

Figs. 5, 6, 10, 19. *Acidaspidella* sp. cf. *A. limita* Rozova, 1963. 5, PMO 108.534, dorsal view,  $\times 5$ . 6, PMO 108.524, dorsal view,  $\times 5$ . 10, 19, PMO 108.541, oblique lateral view,  $\times 3$ , and dorsal view,  $\times 3$ . Upper Cambrian, Kulyumbe River, north-west Siberia. This material is the same as that listed as *A. bella* Pokrovskaya, 1961 *nom. nud.*

Fig. 7. *Acidaspides lermontovae* Tchernysheva, 1953. CGML 93/7109, PMO 108.533, dorsal view,  $\times 9$ . Late middle Cambrian, Aldan River, eastern Siberia. Original of Tchernysheva 1953, pl. 6, fig. 17.

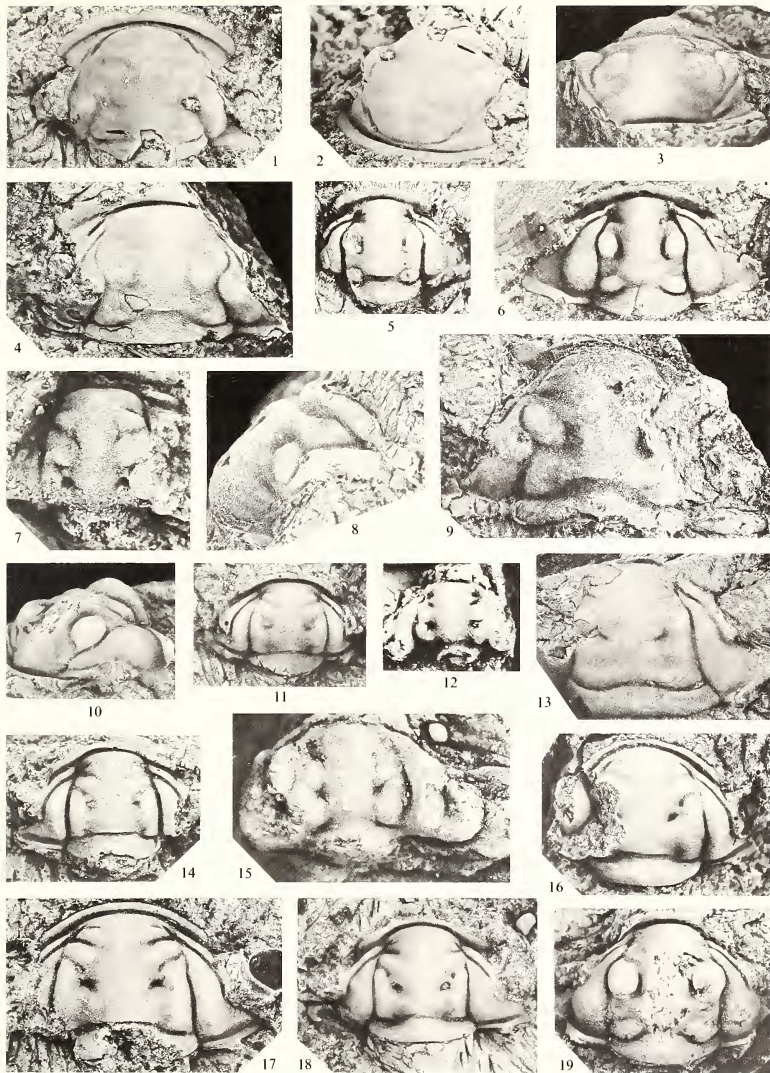
Figs. 8, 9. *Eoacidaspis salairica* Poletaeva, 1956. Paratype, PMO 108.538, left lateral and dorsal views, internal mould,  $\times 2$ . Upper Cambrian, Salair Ridge, western Siberia.

Figs. 11, 14, 16–18. *Acidaspides borealis* Tchernysheva, 1960. 11, CGML 34/9180, PMO 108.535, dorsal view,  $\times 6$ , original of Tchernysheva 1960, pl. 53, fig. 9. 14, CGML 35/9180, PMO 108.523, dorsal view,  $\times 5$ , original of Tchernysheva 1960, pl. 53, fig. 10. 16, PMO 108.527, dorsal view,  $\times 6$ . 17, PMO 108.526, dorsal view,  $\times 5$ . 18, PMO 108.540, dorsal view,  $\times 3$ . Upper Cambrian, Olenek River, north-east Siberia.

Figs. 12, 15. *Acidaspides precurrens* Lermontova, 1951. 12, paralectotype, CGML 56/7350, PMO 108.528, dorsal view,  $\times 10$ , original of Lermontova 1951, pl. 6, fig. 7. 15, lectotype (here chosen), CGML 53/7350, PMO 108.530, dorsal view,  $\times 10$ , original of Lermontova 1951, pl. 6, fig. 4. Upper Cambrian, Kazakhstan.

Fig. 13. *Acidaspidina plana* Lazarenko, 1960. CGML 45/8617, PMO 108.532, dorsal view,  $\times 2$ . Original of Lazarenko 1960, pl. 4, figs. 9, 10. Upper Cambrian, Yenise River, north-west Siberia.





BRUTON, Cambrian odontopleurid trilobites

*Diagnosis.* Holaspid and juvenile cranidia with L1 the larger lobe, at least twice the size of L2, widest at base, tapering forwards, longest axis parallel to dorsal furrow. S1 directed backwards and inwards at 45°, deepest adjacent to dorsal furrow, separated by raised bridging area from circular pit at inner end. S2 short, backwardly and inwardly directed, S3 transverse. Dorsal furrows gently curved convex outwards, deepest posteriorly. Eye ridges narrow, eyes positioned opposite anterior half of L1. Occipital ring with backwardly curved posterior margin, small occipital spine. Anterior branch of facial suture straight, posterior branch diverging outwards at slightly greater than 90°. Posterior border furrow deep, margin with short spines. Anterior border furrow narrow, deep, margin upturned. Surface with fine granules.

*Discussion.* The cranidium figured by Lermontova (1951, pl. 6, fig. 4) is here selected as lectotype for the type species *A. precurrens*. This is refigured herein as Pl. 88, fig. 15, together with an additional cranidium (Pl. 88, fig. 12), figured by Lermontova (1951, pl. 6, fig. 7), which is selected as paralectotype. Both specimens are juvenile stages or very young holaspids and show remarkably many of the characteristic features of certain post-Cambrian odontopleurids. These include the small L3 lateral lobe known in *Primaspis* and *Miraspis*, the palpebral lobe and posterior part of the fixed cheek overhanging the posterior margin as in *Miraspis*, and prominent paired spines on the median glabellar lobe, a feature of the Miraspidinae.

The exact stratigraphical range of the type species is somewhat in doubt. It was originally recorded from the local Kazakhstan Zone of *Lotagnostus trisectus*, thought to be equivalent to the Swedish upper Cambrian Zone of *Peltura scarabaeoides*, although it could be as young as basal Tremadoc. Reasons for this are based on hitherto undescribed material of *A. cf. precurrens* from the so-called Chokuk Horizon of the Anabar Massif.

A pygidium was assigned to *A. precurrens* by Lermontova (1951, pl. 6, fig. 8) on account of its spinose posterior margin. It is the only specimen of this type known and its affinity with the cranidia is very doubtful, as acknowledged by Lermontova.

A number of well-preserved cranidia of *A. borealis* Tchernysheva, 1960 are known from the basal upper Cambrian of the Olenek River. These include two of the cranidia figured by Tchernysheva (1960b, pl. 53, figs. 9, 10; Pl. 88, figs. 11, 14 herein) and three additional cranidia, all topotypes. This material is of holaspids and is amongst the best preserved of any Cambrian odontopleurids. The resemblance to members of the Miraspidinae is less obvious and the glabellar lobation more closely resembles that of early members of the Odontopleurinae including *Primaspis whitei* Whittard, 1961 and *P. multispinosa* Bruton, 1965 from rocks of Llandeilo age in Norway, Salop, and South Wales (see Bruton 1965, p. 11). In this respect the structure of L1 in *A. borealis* is of interest because it has a posterior furrow partly delimiting a small subsidiary basal lobe. Such a lobe becomes separated in early *Primaspis* to form the occipital lobe (cf. *P. whitei* Whittard, 1961, pl. 27, figs. 3, 4). This feature is also known in species of *Odontopleura* (*O. ovata*; see Bruton 1968, pl. 1, fig. 1). *Acidaspis* (*A. cincinnatiensis*; see Whittington 1956a, pl. 59, fig. 9), and in *Diacanthaspis* it is either well developed or scarcely so (Whittington 1956b, p. 211).

The resemblance of holaspid *Acidaspidetes* and *Acidaspidella* to the *Primaspis*-*Leonaspis* group thus extends the stratigraphical range of the root-stock of the Odontopleurinae (cf. Whittington 1956b, p. 90, 1966). Early growth stages of *Acidaspidetes* also resemble members of the Miraspidinae suggesting that this subfamily is closer to the Odontopleurinae than previously thought.

The earliest occurrence of *Miraspis*, from the Arenig of Sweden (Whittington and Bohlin 1958), shows that the Miraspidinae must have been already well differentiated before this time.

*Acidaspidetes lermontovae* Tchernysheva, 1953 is based on an early growth stage from the Maya Stage, Aldan River, eastern Siberia, in beds equivalent to the Swedish middle Cambrian Zones of *Lejopyge laevigata* and *Triplagnostus hundgreni*. Whilst not well preserved, the cranidium (Pl. 88, fig. 7) does show three glabellar lobes and the characteristic S1 furrow with shallow median bridging portion separating the outer furrow from an inner pit.

*Stratigraphical and geographical distribution.* Middle Cambrian, Aldan River, eastern Siberia. Upper Cambrian, Olenek River, north-east Siberia, Kazakhstan.



Genus *Acidaspidella* Rozova, 1963

Plate 88, figs. 5, 6, 10, 19

*Type species. Acidaspidella limita* Rozova, 1963, p. 9, pl. 1, fig. 4, from the early upper Cambrian, Kulyumbe River, north-west Siberian Platform.

*Diagnosis.* Glabella and fixed cheeks strongly convex. Dorsal furrows curved around outer surface of L2. Latter the larger, most prominent, completely circumscribed by S2. S1 broad and shallow. L1 outlined by independent convexity and deepened outer portion of occipital furrow around base. Longitudinal furrows shallow, median glabellar lobe rectangular with long anterior portion. L3 short, backwardly directed and lying in pit at end of eye ridge and fixed cheek. Occipital ring longest (sag.) with centrally placed tubercle. Anterior border furrow narrow, margin turned dorsally. Eyes positioned on transverse line through L2. Anterior branch of facial suture directed straightforward from base of eye, posterior branch directed outwards at a little more than 90°. Dorsal surface granulated, spine from posterior margin.

*Discussion.* Rozova (1964, p. 57) attributed the authorship of the genus to Pokrovskaya, but selected *A. limita* Rozova, 1963 as type species. Dr. Pokrovskaya (pers. comm.) informs me that *Acidaspidella* Pokrovskaya 1961 *nom. nud.* was still undescribed in 1963 and that Rozova is to be considered the author of the genus. I have not seen the type material, but that figured herein from the collections of Drs. Lazarenko and Pokrovskaya is probably the same species. All this material is from the Sukan and Kulyumbe River areas on the north and north-west Siberian Platform. It was listed as *A. bella* Pokrovskaya, 1961 *nom. nud.*, p. 268, and occurs in the early upper Cambrian Zone of *Glyptagnostus stolidus*.

As in the younger *Eoacidaspis*, the L2 glabellar lobe of *Acidaspidella* is the most prominent but the longest axis of the lobe is parallel to an exsagittal line and not oblique to it. Two small specimens including the one figured on Pl. 88, fig. 6, show the broken bases of spines along the posterior margin but these cranidia are probably those of holaspids. *Acidaspidella* and *Acidaspides* both have a convergent anterior facial suture and a narrow upturned anterior border. In *Acidaspidella*, however, the independent convexity of the lateral lobes, the deepened longitudinal furrow, and the long frontal lobe with effaced L3 are distinguishing features. *Acidaspidella* is placed in the Odontopleurinae because of its resemblance to *Odontopleura* and *Leonaspis*.

*Stratigraphical and geographical distribution.* Early upper Cambrian, Yenise River, eastern Siberia. Upper Cambrian-?basal Ordovician (Chokuk Horizon), northern Siberian Platform.

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